Jeanine A Poltronieri
Executive Director
External Affairs

AT&T Services, Inc.
1120 20th Street, NW
Suite 1000
Washington, DC 20036

T: 202.457.2042
F: 202.457-2062

October 8, 2008

Electronic Submission

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, Room TW-A325
Washington, DC 20554

Re: WT Docket No. 07-195, Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band and WT Docket 04-356, Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz and 2175-2180 MHz Bands

Dear Ms. Dortch:

On October 7, 2008, Jeanine Poltronieri, David Shively and Mike Roden of AT&T met Julius Knapp, Chief of the Office of Engineering and Technology, as well as Ronald Repasi, Mark Settle, Patrick Forster, Ahmed Lahjouji and Ira Keltz. Mr. Shively and Mr. Roden joined the conversation via telephone. AT&T discussed the ongoing proceedings involving spectrum at 2155-2175 MHz and in the 1915-1920 MHz, 1995-2000 MHz and 2175-2180 MHz bands

AT&T reviewed the attached presentation and expressed its view that the Commission should ensure that appropriate controls are put in place to prevent interference into the PCS and AWS-1 bands.

Pursuant to Section 1.1206 of the Commission's rules, please place a copy of this letter in the dockets of the above captioned proceedings. Should you have any questions please contact the undersigned.

Sincerely,

/s/ Jeanine Poltronieri
Executive Director

Attachment

cc: Julius Knapp
Ronald Repasi
Mark Settle
Patrick Forster
Ahmed Lahjouji
Ira Keltz

AWS-3 & H-Block Interference Issues

Oct. 7, 2008

Introduction

- AT&T currently operates cellular and PCS networks serving approx. 73 million voice and data customers
  - 2G voice and data using GSM/EDGE throughout US
  - 3G voice and data services based on UMTS and HSPA deployed in over 300 metro areas

- Also announced plans to move to a next generation technology, LTE, using spectrum holdings in the 700 MHz band and the AWS-1 band
  - LTE will bring additional broadband wireless services to millions of customers

- AT&T (and formerly Cingular Wireless) has been active in both the H-Block and the AWS-3 proceedings and remains convinced that interference will occur if current proposals are adopted
  - Confirmed by the recent FCC testing with T-Mobile in Seattle which included representatives from AT&T

H-Block Recommendations

- As AT&T has previously commented, interference due to H-Block operations can affect other PCS devices
  - While H-Block devices would use frequency division duplexing (FDD), the interference scenarios are similar to AWS-3 due to close proximity of downlink and uplink channels
  - 10 MHz duplex separation (similar to 10 MHz guard band)

- For H-Block, out of band emissions falling into the PCS mobile receive band should be limited to -66 to -61 dBm/MHz
  - Consistent with prior CTIA-sponsored tests on PCS devices performed at 2 independent test labs
  - Consistent with recent T-Mobile/FCC test results on OOBE for AWS-3
  - Consistent with existing specifications for 2G and 3G equipment that have been adopted in North America and worldwide

- On H-Block power limits, AT&T continues to support +13 dBm / 5 MHz in H-Block based on comprehensive testing performed on PCS devices
  - Multiple devices, multiple test labs, including temperature variations
  - Intermodulation issue unique to H-Block (affects B-Block PCS)

AWS-3 Recommendations

- The best use of AWS-3 spectrum is downlink-only operation
  - Consistent with AWS-1 band at 2110-2155 MHz (downlink-only per Part 27)
  - Consistent with MSS operation above 2180 MHz (downlink)
  - Consistent with other world-wide spectrum allocations for 3G services
  - Provides highest value to AWS-3 spectrum

- If the 2155-2175 MHz band cannot be paired with 1755-1775 MHz then it is also possible to accomplish other pairings and/or develop asymmetrical pairings with existing bands
  - Still allows 2155-2175/80 MHz to be used as downlink, making the best use of the spectrum
  - Also allows anyone to bid at auction and develop whatever service or business becomes feasible

- If TDD operation is to be allowed in AWS-3 then stringent limits and/or guard bands are needed to prevent interference
  - With no guard band, the AWS-3 mobile transmitter is directly adjacent to an AWS-1 receiver

AWS-3 Interference

- If AWS-3 spectrum is used for mobile transmissions then interference to AWS-1 mobile receivers will occur
  - Confirmed in recent testing by T-Mobile in Seattle (Sept. 3-5, 2008)
- Interference due to 2 sources:
  - Fundamental AWS-3 signal at frequencies between 2155 to 2175/80 MHz can affect AWS-1 receivers
  - Out of band emissions from AWS-3 that fall directly into AWS-1 receive band
    - Cannot be mitigated by AWS-1 receiver

Test Cases

1. Combined OOBE and Receiver Overload Tests
- UMTS serving signal 5MHz wide centered at 2152.5 MHz
- AWS-3 interfering signal 5 MHz wide at 2157.5 MHz, 2162.5 MHz, 2167.5 MHz and 2172.5 MHz
- AWS-3 OOBE similar to FNPRM (60 + 10logP)

2. Improved AWS-1 Receive Filtering Tests
- UMTS serving signal 5MHz wide centered at 2112.5 MHz
- AWS-3 interfering signal 5 MHz wide at 2107.5 MHz, 2102.5 MHz, 2097.5 MHz and 2092.5 MHz
- AWS-3 OOBE similar to FNPRM (60 + 10logP)

3. WiMAX as Interfering Signal Source Tests
- UMTS serving signal 5MHz wide centered at (a) 2152.5 MHz and (b) 2112.5 MHz
- AWS-3 interfering signal with 20 MHz centered at (a) 2167.5 MHz and (b) 2097.5 MHz
- AWS-3 signal with 25% activity factor
- AWS-3 OOBE same or better than FNPRM (60 + 10logP)

4. OOBE Tests
- Spectral analysis of the AWS-3 signal to examine OOBE power at different frequencies
- Interference tests with UMTS serving signal 5MHz wide centered at 2152.5 MHz and AWS-3 signal 5 MHz wide centered at 2152.5 MHz

5. Receiver Overload Tests
- Analyze custom filter rejection characteristics and determine insertion loss
- Repeat tests (1) and (2) with custom filters on both sides of AWS-1 band

Protection from AWS-3 Interference

- Joint T-Mobile/FCC testing confirmed that interference will occur at a signal level of -32 dBm in the adjacent AWS-3 band resulting in AWS-1 voice call to be completely “dropped”
  - Only 1 device tested in T-Mobile/FCC testing
  - Similar testing performed for Ofcom showed interference at levels of -47 to -28 dBm (geometric mean = -38 dBm, slightly lower than the one value in T-Mobile/FCC testing)
  - Using Ofcom’s results suggests a power limit for the first adjacent channel to be:
    -38 dBm + 39 dB (path loss) + 3 dB (body loss) = +**4 dBm**
  - If only the T-Mobile/FCC result is used then this corresponds to an AWS-3 device transmitting at:
    -32 dBm + 39 dB (path loss) + 3 dB (body loss) = +**10 dBm**
  - Both of these results are significantly lower than the current FCC proposal (+23 dBm/MHz) and the M2Z proposal (+33 dBm)
  - Testing also confirmed that this type of interference would also affect AWS-1 devices in other AWS-1 spectrum blocks

- Joint testing also confirmed interference due to AWS-3 out of band emissions will be a significant problem
  - AWS-1 call “dropped” with interference at -96 dBm
  - Corresponds to an OOBE limit of -60 dBm/MHz (attenuation = 90+10log(P))
  - Significantly lower than the current proposal
    - Similar to H-Block proposals and relevant industry standards

Ofcom Reports, M2Z Comments, etc.

- AT&T has reviewed the Ofcom reports and measurement results
  - Several areas of agreement
    - Front-end filter attenuation; measured results demonstrate interference to mobile receiver; power limits provide implied guard band
  - Some areas of disagreement
    - Report did not address interference to UMTS voice services; interference seen only when data service throughput goes to zero; cell radius not representative of networks in US; no penetration loss for buildings

- AT&T believes that the comments from M2Z are technically incorrect and misleading
  - Consistently misinterpret UMTS and CDMA power levels
  - Misleading claims regarding operation of WCDMA-based systems
  - Incorrect characterization of the measured results
  - Conclusions not supported by results of testing

- Additional details in following slides

Definitions for UMTS Signal Levels

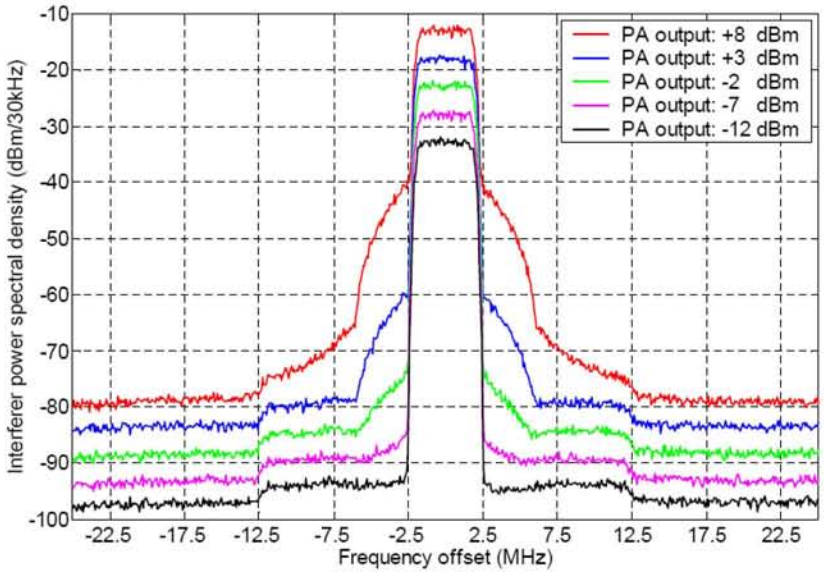
- When evaluating UMTS or CDMA-based systems, correct definition of power levels must be used:
  - Total receive power = $\hat{I}_{or}$ = total downlink (intended) power received at the mobile device
    - Includes pilot, control, voice, & data on all downlink codes from intended base station
  - Downlink pilot power = RSCP (=CPICH_Ec)
    - Typically 10 dB lower than $\hat{I}_{or}$ (i.e. CPICH_Ec/Ior = -10 dB)
- NOTE:
  - In Ofcom reports
    - Received UMTS power = $\hat{I}_{or}$ (full downlink power)
  - In T-Mobile lab testing
    - Received UMTS power = CPICH_Ec (downlink pilot power only)
- Correct interpretation must be used to compare signal levels

Ofcom Report – Interfering Signal

- Measurements performed for Ofcom show the emission mask of the devices met the 3GPP specifications
  - Spectra can be seen in Figure 19 of the Ofcom report
  - As output power of the device increases, the out of band emission power also increases
- Although this is different than that used in the joint T-Mobile/FCC testing, the results of the joint testing can be used with the correct interpretation
  - As seen in the figure, results with signals from mobile devices will be worse
  - Device used to produce the interfering signal in the T-Mobile/FCC testing showed much “cleaner” emission mask, but out of band energy was still determined to interfere with an AWS-1 receiver

Figure 19 from

Ofcom Report



Ofcom Report – UMTS Receiver Performance

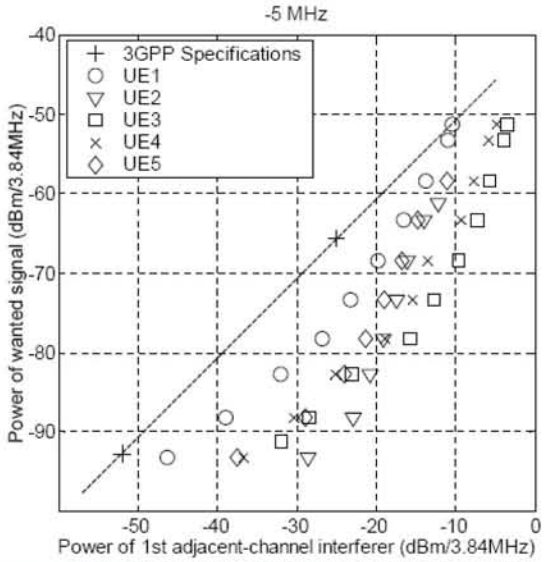
- Adjacent channel interference seen with interferer at -28 to -47 dBm
  - Test case similar to T-Mobile test with pilot power at -105 dBm w/ no guard band
- With 5 MHz guard band (10 MHz blocking test) interference at -27 to -32 dBm
- With 10 MHz guard band (15 MHz blocking test) interference at -20 to -26 dBm
- Intermodulation also seen as an interferer at levels of -28 to -30 dBm
- Some of the measured results were produced with the intended signal approx. 11 dB higher than required by the 3GPP spec.

- **With correct interpretation, Ofcom measurements are consistent with results from T-Mobile / FCC testing**

Offset	T-Mobile/FCC	Ofcom
5 MHz	-32 dBm	-28 to -47 dBm
15 MHz	-23 dBm	-20 to -26 dBm

- Note that the T-Mobile/FCC results here are those results measured with the AWS-3 filter used to remove the out of band emissions into the AWS-1 band.

Figure 23: Measured variation of P_s versus P_{AC} for UEs in the presence of an interferer at the 1st adjacent channel (–5 MHz), and for a DL bit-error rate of 10^{-3}.



Ofcom Sharing Study - Assumptions

- Sharing study in the 2.6 GHz band concentrated on mobile to mobile interference from TDD mobiles (into FDD receiver)
- **All results depend on the assumptions and values used in the models**
  - Looked at data throughput, not voice
    - Data services typically operated at higher BLER target compared to voice
      - Data services: BLER=10%
      - Voice service: BLER=1%
  - The Ofcom report equates receiver blocking and receiver saturation. However, these are not necessarily equal as was clearly shown in Ofcom's measurement report
    - Even when operating in its linear region there is distortion in the receiver due to 2nd and 3rd order non-linearities and also due to the overall selectivity
    - Also depends on signal strength of intended signal
    - These effects can be clearly seen in measured results from Ofcom and and also from the T-Mobile/FCC testing
  - Ofcom includes some amount of attenuation due to front-end filtering
    - Modest attenuation of 0, 4, 8 and 12 dB for offsets of 5, 10, 15, and 20 MHz
    - 0 dB attenuation for TDD blocks that are within the assumed FDD filter
    - As many have commented in the H-Block and AWS-3 proceedings, there is little attenuation in the first 10-15 MHz of spectrum from the block edge

Ofcom Sharing Study – Assumptions (2)

- Cell layout for FDD assumed 1 km cell radius
  - In many cases in the US the cell radius is larger for networks operating at PCS and AWS frequecies
    - Risk of interference rises as the desired signal would be lower than Ofcom used
    - Also, Ofcom used no loss for building penetration
  - AT&T agrees with T-Mobile's comments that a UMTS pilot power of -105 dBm is realistic for networks operating in the US

- In looking at the data throughput, Ofcom assumed that receiver saturation would result in complete loss of throughput
  - Ofcom used a threshold of -10 dBm to model saturation (and hence zero throughput)
  - While Ofcom claims that this is conservative, this ignores the blocking effects present when the desired signal is lower
    - This was clearly shown in the Ofcom measurement report and in T-Mobile/FCC testing
    - Interference seen at -28 to -47 dBm in first adjacent channel
  - This would lead to interference to AWS-1 devices and dropped calls in the case of a voice service as shown in the T-Mobile/FCC testing

Ofcom Sharing Study - Results

- Sharing study concluded that both the ACS and ACLR contribute to the interference seen at the mobile station (i.e. the ACIR) but the ACLR of the interferer was seen as the most problematic
  - Similar to findings of the T-Mobile/FCC testing
  - In the case of reduced Tx power, Ofcom used slightly improved ACLR, and hence an improved ACIR

- With all of the assumptions used (some that we may not agree with), Ofcom found “risk of significant 1st adjacent-block interference from TDD terminal stations towards FDD terminal stations, where the TDD terminal stations are served by high power macro-cellular base stations”

- In the case of pico-cell deployment in the 1st adjacent channel the risk of interference was seen to decrease
  - Base station power limited to 25 dBm / 5 MHz (EIRP)
  - This also means that the transmit power of TDD devices is reduced
  - Effectively provides guard band between AWS-3 and AWS-1

M2Z's Comments

- M2Z describes the -105 dBm signal levels used as being too low and not realistic
  - This is technically incorrect as the reference sensitivity of a UMTS device is defined at -117 dBm for voice service
  - In addition, as described above the -105 dBm is the pilot level and the full downlink receive power ($\hat{I}_{or}$) would be approx. -95 dBm
    - Approximately 12 dB **above** the reference sensitivity
  - Furthermore, AT&T agrees with T-Mobile that the downlink RSCP distribution provided by T-Mobile is representative of UMTS networks in North America

- M2Z has also said that these signals, at or below the thermal noise floor, could not be useable by mobile devices
  - This is technically incorrect as any communications system using processing gain can operate below the noise floor
    - Fundamental property of spread spectrum and CDMA-based systems
    - Devices are tested to operate correctly at reference sensitivity, i.e. approx. 18 dB **below** the thermal noise floor
  - Similar approaches have been used for other services for decades (e.g. DoD)

M2Z's Comments (2)

- M2Z further confuses the issue of operating at -105 dBm by claiming that this represents a 30 dB increase in terms of protection from interference and is impractical
  - This is technically incorrect and obfuscates the issue
  - UMTS and other wireless standards define levels of Tx power that are allowed into the mobile receive bands
    - In the case of UMTS this limit is: Tx power = -60 dBm/3.84 MHz
    - At 1 meter separation, this yields interference at approx. -102 dBm which allowes devices to coexist
      - This is exactly why the wireless standards include limits on power emitted into the receive bands (provides coexistence)
  - This is not the "detrimental impact" as M2Z claims
    - All UMTS devices must meet this limit
    - Limits for GSM devices are similar
    - CDMA-2000 devices are even more stringent
    - Hundreds of millions (even billions) of wireless devices are meeting these limits today and are making efficient use of the spectrum resources

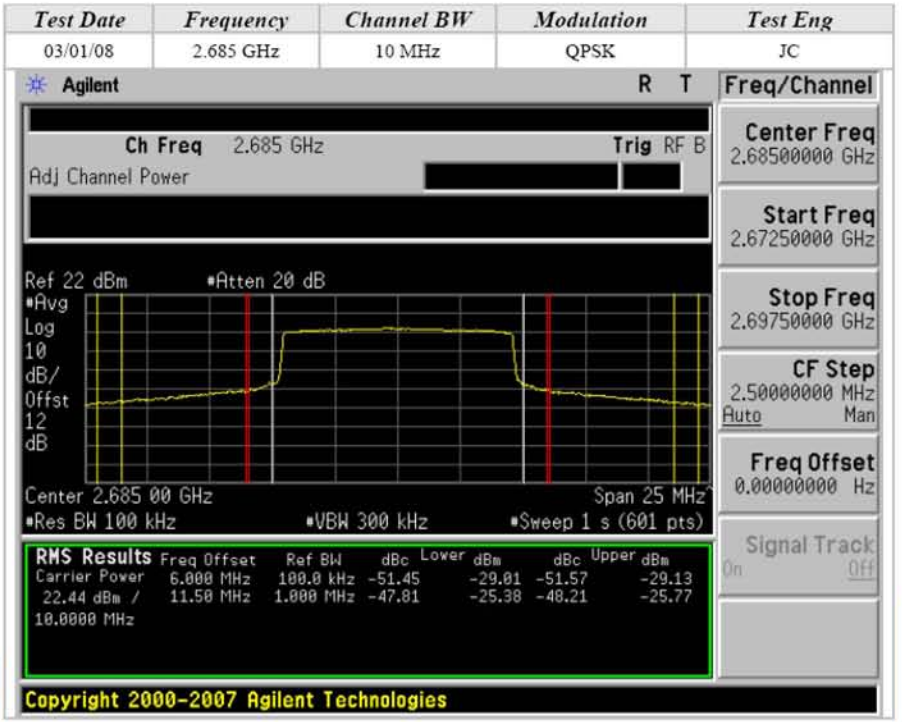
M2Z on T-Mobile/FCC Tests

- M2Z presents several ideas on why the T-Mobile/FCC tests were flawed
- However, all of these reasons are technically incorrect and misleading

- M2Z claims that UMTS would not work in a TDD mode and was therefore not representative of signals in AWS-3
  - This is obviously incorrect since a TDD version of UMTS has been completely standardized by 3GPP for several years
    - Developed and deployed by IPWireless
  - Deployed in unpaired spectrum in Europe and throughout the world
  - Also being deployed now in NY City for broadband public safety in the 2.6 GHz band

M2Z on T-Mobile/FCC Tests (2)

- M2Z also claims that out of band emissions (OOBE) from WiMAX will be lower than UMTS
  - This is incorrect as OFDM transmitters exhibit a relatively broad emission spectrum in the first several MHz outside of the desired channel bandwidth
    - This is further exacerbated for wider channel bandwidths (10, 15, 20 MHz)
    - Higher Tx power levels will also show an increase in the out of band emissions (Note that M2Z proposes 33 dBm compared to 23 dBm for typical UMTS devices)
- Example WiMAX device
  - FCC ID: PD9533ANXMU
  - 10 MHz bandwidth, 23 dBm max.
  - At offset of 11.5 MHz from the center frequency the OOBE is approx. -25.6 dBm/MHz



M2Z on T-Mobile/FCC Tests (3)

- M2Z suggests that the T-Mobile testing was flawed due to the signal characterics of the interference source signal generator
  - This is completely incorrect
  - While the device used did have characteristics that can be different from handheld devices, the results obtained can still be used with the appropriate understanding
    - Similar approaches were used in the Ofcom report to combine the ACS and ACLR to obtain the ACIR (or to determine the ACS)
  - In addition, during the T-Mobile testing additional filters were readily available to clearly separate the ACS and ACLR to obtain separate results
    - Filter was used as has been documented by the FCC's report of the testing (FCC OET memorandum, Sept. 12)
      - Contrary to what M2Z claims
    - During the testing M2Z made no request to perform additional testing using the available filters

M2Z on T-Mobile/FCC Tests (4)

- M2Z states that an out of band attenuation of 49+10log(P) will be sufficient to protect AWS-1 mobile receivers
  - This conclusion is not supported by the T-Mobile/FCC test results or the Ofcom report
  - As explained previously all CMRS handsets provide significantly more attenuation to avoid mobile to mobile interference
    - For example, -66 dBm/MHz is equivalent to 96+log(P)
    - Proposed value yields 47 dB less protection compared to the hundreds of millions of devices already deployed
- M2Z also proposes that AWS-3 devices should be allowed to transmit at 33 dBm
  - This conclusion is not supported by the T-Mobile/FCC testing or the Ofcom report
  - Both measurement campaigns show that mobile receivers will suffer interference in close proximity to other mobile devices

M2Z on T-Mobile/FCC Tests (5)

- M2Z has characterized the T-Mobile tests as “flawed” yet still contends that the test results support their proposed power and OOBE limits
  - Obviously this is nonsense
  - AT&T believes that the tests were not flawed
    - On the contrary, the technical results can be used in the technically correct manner
- M2Z consistently mischaracterizes the signal levels involved by ignoring the characteristics of CDMA-based technologies
  - As explained previously, with the pilot signal at -105 dBm, the total downlink receive power would be approx. 10 dB higher
  - M2Z points to the FCC’s decision on UWB as using a PCS receive power level of -96 dBm
    - In the UWB proceeding, the FCC analysis of the PCS link did quote a receive power level of -96 dBm
    - In that context the -96 dBm value was the total Rx power ($\hat{I}_{or}$) and thus the pilot power would be approx. -106 dBm
  - With the correct technical interpretation this is consistent with the T-Mobile/FCC testing and analysis
    - i.e. pilot power = -105 dBm

Conclusions

- AT&T has attempted to set the record straight and has provided clarifications on previous measurements and studies carried out by Ofcom
- AT&T has also clarified several points raised by M2Z that are technically incorrect and misleading
- AT&T continues to support previous testing on H-Block
- AT&T supports the results of the joint T-Mobile/FCC testing conducted in Seattle, Sept. 3-5, 2008
  - Test results confirm that more stringent power limits and more stringent out of band emission limits are needed in AWS-3 spectrum if mobile transmissions are allowed